

1. A flywheel energy storage system, comprising:
an energy storage flywheel supported on a bearing system for rotation about a substantially vertical axis inside a container with an internal low friction atmosphere;
a motor and a generator for accelerating and decelerating said flywheel for storing and retrieving energy; and
a tilt sensor that detects if the orientation of the axis of rotation is outside a predetermined tolerance from vertical, and produces a signal to trigger appropriate corrective actions.
2. A flywheel energy storage system as described in claim 1, wherein:
said bearing system is comprised of magnetic bearings.
3. A flywheel energy storage system as described in claim 2 wherein:
said magnetic bearings provide passive radial centering force to said flywheel.
4. A flywheel energy storage system as described in claim 2 wherein:
said magnetic bearings use active radial control.
5. A flywheel energy storage system as described in claim 1 wherein:
said bearing system is comprised of a combination of magnetic and mechanical bearings.
6. A flywheel energy storage system as described in claim 5 wherein:
said magnetic bearings are used to provide axial lift force to the flywheel and said mechanical bearings provide radial centering force.
7. A flywheel energy storage system as described in claim 1 wherein:
said tilt switch detects excessive tilting of said flywheel energy storage system when the axis of rotation of said flywheel is more than 10 degrees from vertical.

8. A flywheel energy storage system as described in claim 1 wherein:
said tilt switch detects excessive tilting of said flywheel energy storage system
when the axis of rotation of said flywheel is more than 5 degree from vertical.
9. A flywheel energy storage system as described in claim 1 wherein:
said tilt sensor includes a mechanical switch.
10. A flywheel energy storage system as described in claim 9 wherein:
said mechanical switch uses a pendulum.
11. A flywheel energy storage system as described in claim 10 wherein:
said tilt sensor includes a pendulum hanging inside an opening in an annular electrical
contact;
whereby said pendulum contacts said annular contact and completes an electrical
circuit to generate said signal when said flywheel energy storage system tilts beyond said
predetermined tolerance from vertical..
12. A flywheel energy storage system as described in claim 1 wherein:
said tilt switch detects if the orientation of the axis of rotation is outside of tolerance
from vertical by detecting if the tilt angle of the axis of rotation is acceptable or not.
13. A flywheel energy storage system as described in claim 1 wherein:
detection of the orientation of the axis of rotation being too far from vertical causes an
alarm within said flywheel energy storage system.
14. A flywheel energy storage system as described in claim 1 wherein:
detection of the orientation of the axis of rotation being too far from vertical causes a
remote alarm.

15. A flywheel energy storage system as described in claim 1 wherein:
detection of the orientation of the axis of rotation being too far from vertical causes prevention of power application to said motor means.
16. A flywheel energy storage system as described in claim 1 wherein:
detection of the orientation of the axis of rotation being too far from vertical causes said flywheel energy storage system to discharge.
17. A flywheel energy storage system, comprising:
an energy storage flywheel supported on bearings for rotation about a substantially vertical axis inside a container with an internal low friction atmosphere;
a motor and a generator for accelerating and decelerating said flywheel for storing and retrieving energy; and
a tilt switch that detects earthquakes.
18. A process of storing and recovering energy in a flywheel energy storage system, comprising:
accelerating a flywheel in rotation about a substantially vertical axis inside a container with a brushless motor, for storing energy in the form of rotational inertia of said flywheel;
decelerating said flywheel with a generator for retrieving said stored energy in the form of electrical energy;
supporting said flywheel for rotation on a bearing system;
detecting if the orientation of the axis of rotation of said flywheel is beyond a predetermined tolerance from vertical through use of a tilt sensor; and
generating a signal with said tilt sensor for signaling corrective action to be taken when said flywheel axis of rotation is beyond said predetermined tolerance from vertical.

19. A process as described in claim 18 wherein:

said corrective action includes activating an alarm if the tilt of said flywheel energy storage system is beyond tolerance.

20. A process as described in claim 18 wherein:

said corrective action includes deactivating said flywheel energy storage system if said tilt of said flywheel energy storage system is beyond tolerance.

11/11/2019 11:11:11 AM